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AUTHOR Harnapp, Vern R.
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ABSTRACT

Fifth grade students can become familiar with images of earth generated by space sensor Landsat satellites which sense nearly all surfaces of the earth once every 18 days. Two false color composites in which different colors represent various geographic formations were obtained for the northern Ohio region where the students live. The class had no previous experience with remote sensing principles or interpretation of satellite images. Following a pretest, students learned factual information such as how images are produced, applied the information to images, examined each image for orientation, and classified geographic features. Students then outlined various land cover types with overhead transparency pens on clear sheets which covered the images. At the conclusion of the unit, students were given an achievement test using two Landsat images not previously presented. The class performed much better on interpretive techniques than on general information. The posttest marked a 100 percent improvement over the pretest; students became proficient in identifying water, forests, land, and transportation lines. The recent price increase, however, for individual prints places the future use of Landsat in the elementary classroom in doubt. (KC)

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THE USE OF FALSE COLOR LANDSAT IMAGERY WITH A FIFTH GRADE CLASS

by

Vern R. Harnapp

The University of Akron

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THE USE OF FALSE COLOR LANDSAT IMAGERY WITH A FIFTH GRADE CLASS[1]

Vern Harnapp

The University of Akron

"Young people today are going to spend the remainder of their lives in a world where information about the earth and its resources will be obtained from space sensors" (Richason, 1978). This fact is borne out daily as children tune in local television news programs where satellite images of weather patterns are flashed on the screen. But this is not the only use for satellite images; there are a plethora of practical applications in agriculture, mapping, resource detection, forest fire monitoring, pollution tracing, and the like. Since children are being exposed to these applications but with little explanation, it seems that the likely place to introduce remote sensing concepts and interpretation techniques is at the elementary level.

Canadian research in Project Omega at the grade three and upper elementary level indicates that false color imagery can be used with success (Kirman, 1977). Since little testing has been done elsewhere to substantiate or negate the findings of Kirman and others, it was decided during the spring of 1982 to devise a learning module and administer it to a fifth grade class in Cuyahoga Falls, Ohio.

Landsat satellites are in a near polar orbit approximately 570 miles high sensing nearly all surfaces of the earth once every 18 days. (Landsat 4 is at 431 miles high with a 16 day cycle.)

[1]Imagery and supporting materials were funded by a grant from The Educational Research and Development Center of The University of Akron.

The images are produced at a nominal scale of 1:1,000,000 and show an area approximately 115 mi^2. These images can normally be enlarged to a scale of 1:250,000 but images for this study were at the scale of 1:1,000,000.

Two false color composite images (FCC) of satellite passes on 8 March 1973 and 26 April 1974 were secured from EROS in Sioux Falls, South Dakota. Both were virtually cloud free images of northern Ohio, including Lake Erie, and part of southern Ontario. These dates were selected so as to give the students a look at an image which had some green vegetation present in very early spring and another which had much growing vegetation at spring's onset. The northern Ohio images were purposely selected since this was the location of the school and, hence, the area would not be totally foreign to the students (even though they had never before seen such satellite imagery). Enough imagery was procured so that each student had an image to work with.

Classroom Phase

Student materials included overhead projection acetates, overhead transparency pens in blue, red, green and yellow, and a 1:1,000,000 FCC paper positive. Other aids available for use by the class included magnifying glasses, a lighted standing magnifier, and copies of the publication Mission to Earth: Landsat Views The World, which were available during free times for individual students to use.

This fifth grade class had no previous experience or information regarding remote sensing principles and techniques in interpretation of satellite images. To assess knowledge gained from the experience, a pre-test was administered at the start of the

first class session and a post-test given at the very end of a week and a half learning period. Imagery used in the post-test was from a different geographical area of Ohio. In that way interpretation techniques could be tested without using the same imagery from which learning took place.

Background information on how the images were procured and produced was then given via lecture method and the use of select visuals produced by NASA and LARS at Purdue University. Each student was given ditto sheets of NASA materials in a special folder for use during the activities with LANDSAT. Class activities consisted of basic factual instruction; questions and application of information to the images before each student; viewing selected slides; examining the image for orientation and classification of geographic features. The class was instructed in means of classifying land cover on an image using a modification of the Level One system devised by James R. Anderson and others (Geological Bulletin #941). Students were then asked to outline various land cover types with overhead transparency pens on clear mylar sheets which covered the images.

The pre-test, in which the class showed a good deal of frustration with this new medium, was followed by 6 periods of instruction, each 40 minutes in length. Basic principles of the electromagnetic spectrum were explained as well as how Landsat satellites gather and transmit information about the earth's surface. This was followed by giving information about latitudinal and longitudinal location of the imagery and basic information contained on notations at the bottom of the imagery. A handout was prepared and gone over regarding how various earth features appear on FCC

images. The class then spent two periods plus class study time interpreting their individual images using Anderson's level one classes. Their interpretations were taken directly from the images and sketched on transparent acetate using overhead projector pens. This part of the exercise was highly delightful to the class. Given their very limited exposure to interpretation techniques it was expected that their interpretations would be simple. Nonetheless, they displayed surprising proficiency in defining areas of water, forest, agricultural land, and transport lines.

This being a project of exploratory nature, no time limit was set for its completion. When it appeared that student interest began to wane and all material had been adequately presented the project was terminated and the post-test given.

At the conclusion of the module a 16 question achievement test was given. Questions were related to two Landsat images which the class had not seen before, but which were part of the state of Ohio.

Test Results

When considering the two parts of the test, general information vs. interpretive techniques, the class performed surprisingly better on the latter section (See Table 1). This may be due to having spent more class time on interpretive techniques than on general information and the higher level of interest on interpreting the images.

A comparison between performance of boys vs. girls appears to be unfair because of the small number of students and wide disparity, 5 boys as against 13 girls. However, both boys and girls performed better on the interpretation section than on the general

information part, with girls doing markedly better on the interpretation section. Overall, the class scored 21% higher on interpretation techniques than on general information (See Table 1). As might be expected, those items most difficult to detect by adult interpreters were also most difficult for this class (i.e., cities and bare ground). Interestingly girls were far more proficient in picking out cities than were the boys.

The degree of improvement on the post-test vs. the pre-test was quite marked as can be seen in Table 2. Overall there was a 100% improvement by the entire class while the five boys in the class scored a 185% gain over the first test.

Findings

Considering the facts that the fifth grade class had no previous experience with Landsat imagery and there were few guidelines available to steer this investigation, the experience was pleasant and informative. Lecture procedure was adapted to the level of the elementary student with the objective of conveying very elemental information and interpretation techniques to the class. Aside from Kirman's research in Canada there were no points of comparison available. However, Kirman's questioning techniques were altered to fit this particular situation.

The relatively poor performance on the general information section of Landsat may be attributed in part to the inexperience of the class in taking notes from lecture style presentation and a lack of printed material for the class to read and study. In future projects of this type more printed material should be made available to the student as an aid to learning.

During the interpretation phase class enthusiasm was high, so much so, that at times the instructor had to slow the pace in order that the class would not miss key points. Yet, that enthusiasm was a positive spur toward investigation and learning.

At the very least it was found, like Kirman's experience, students at this level were capable of eliciting basic land cover information from FCC images. Similarly this class had difficulty comprehending distances on the image and detecting small towns. This latter point is also a problem for adult investigators. Once the class became accustomed to viewing plants as being "red", identifying areas of vegetation was not difficult. When called upon to outline areas of farmland students had difficulty because a degree of generalization was necessary and individual fields were hard to detect and outline. The class was quite adept at identifying water bodies and transport lines although, occasionally, a stream might be confused with a road.

Finally, a cautionary note should be given. At this point, I am somewhat pessimistic about future use of Landsat in the elementary classroom largely because of the significant price increase in the cost of imagery which took effect October 1 of 1982. For this project individual paper prints cost $15 but that has increased 3-fold to $45 per print. Unless grant monies are available it is doubtful that schools will be willing or able to make money outlays of that magnitude.

TABLE 1

POST-TEST SCORES ON LANDSAT IMAGES

TEST QUESTIONS	Boys N=5 (Percent Correct)	Girls N=13 (Percent Correct)	Total N=18
General Information Section			
1. What is the scale of a Landsat image?	0	0	
2. On a Landsat image, what direction is the top of the image?	67	13	
3. On a Landsat image, how many miles does one inch represent?	67	100	
4. What is the latitude of your image? (Give the two sets of numbers for your image.)	67	75	
5. What is the longitude of your image? (Give the two sets of numbers for longitude.)	67	75	
6. How many orbits a day does Landsat make?	33	13	
7. How many minutes does it take for Landsat to make one orbit?	33	13	
8. At about what time every day does Landsat cross the equator?	67	38	
9. What date was this image taken?	100	88	
	56	46	
Image Interpretation Section			
1. Find a road	67	50	
2. Find a lake	100	100	
3. Find a city	0	63	
4. Find forest	100	75	
5. Find bare ground	33	25	
6. Find crops actively growing	33	63	
7. Find clouds	67	88	
8. Find an island	100	100	
9. Find water with sedimentation	67	63	
10. Find clear water	100	100	
	67	73	

TABLE 2

COMPARISON OF PRE-TEST WITH POST-TEST PERFORMANCE

	Pre-Test (Exam) Percent Score	Post-Test (Exam) Percent Score	Percent Improvement
Full Class	29	58	100
Boys	21	60	185
Girls	29	56	93

FOOTNOTES

Richason, Ben Jr., Field Study for Remote Sensing. NASA Conference Publication 2155, Moffett Field, Calif., March, 1978, p. vi.

Kirman, Joseph M., "The Use of Infra-Red False Color Satellite Maps by Grades 3, 4, and 5 Pupils and Teachers". Alberta Journal of Educational Research, 23 March 1977, pp. 52-64.

Anderson, James R. et. al, "A Land Use and Land Cover Classification System for Use With Remote Sensor Data", Geological Survey Professional Paper 964, U.S. Government Printing Office, Washington, D.C., 1976.